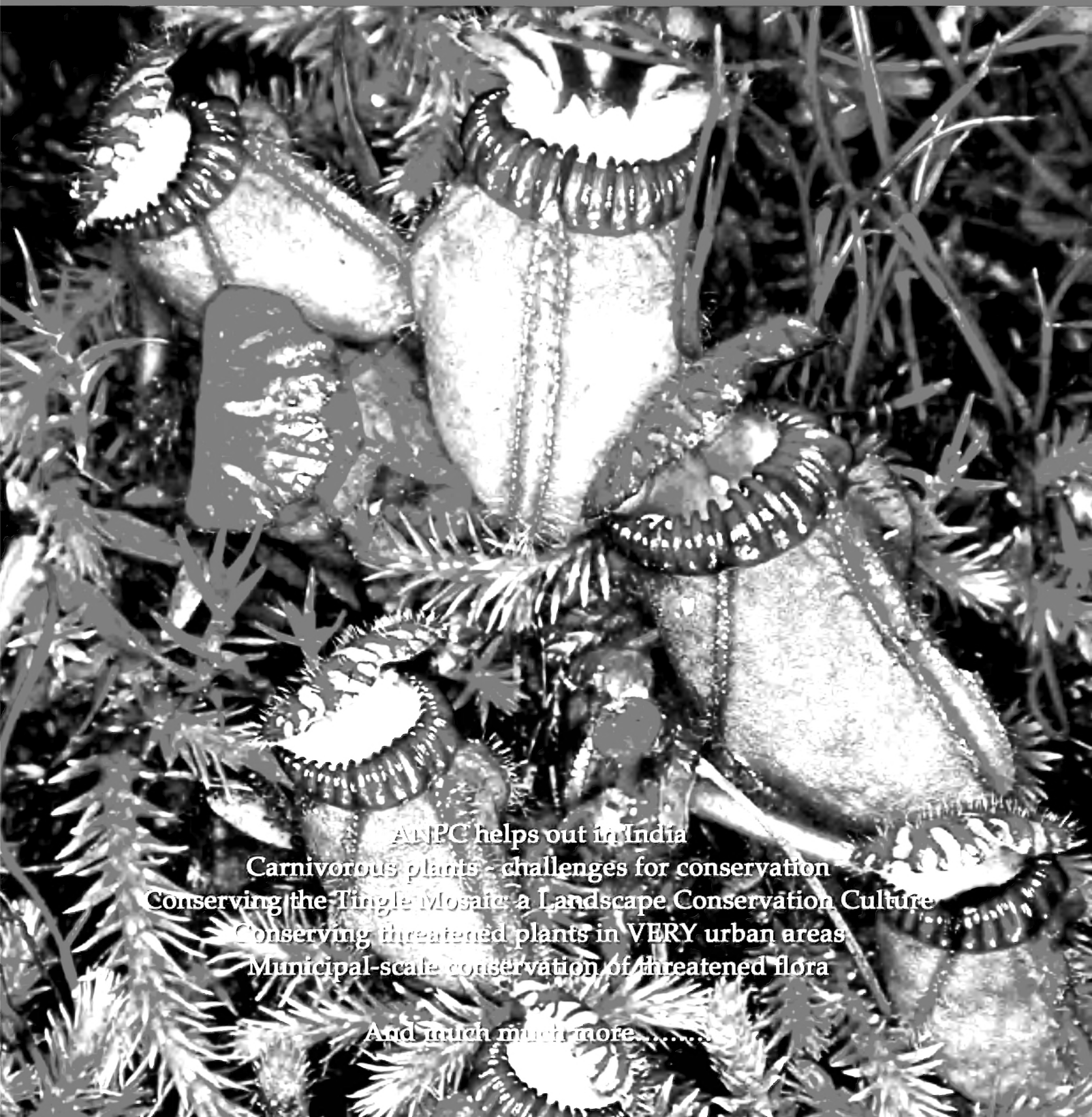


# Australasian Plant Conservation

BULLETIN OF THE AUSTRALIAN NETWORK FOR PLANT CONSERVATION

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ANPC helps out in India

Carnivorous plants - challenges for conservation

Conserving the Tingle Mosaic: a Landscape Conservation Culture

Conserving threatened plants in VERY urban areas

Municipal-scale conservation of threatened flora

And much much more.....

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**Front cover:** *Cephalotus follicularis*,  
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# President's report

*Judy West*

*Centre for Plant Biodiversity Research  
CSIRO Plant Industry*

Since the last time I wrote some notes on our activities we have held a very successful National Conference in Adelaide. The conference **Plant Conservation: The Challenges of Change** was hosted jointly with the South Australian Department for Environment and Heritage and the Botanic Gardens of Adelaide and I wish to thank all those involved for helping to organize a smooth running and stimulating meeting.

Although the number of participants (just over 100) was slightly less than expected, their areas of interest were broad and covered the spectrum of activities relating to plant conservation. This ANPC National Conference is really the only venue of its kind in that it brings together the on-ground practitioners together with researchers and policy makers, and certainly stimulates thoughtful debate and discussion. The opportunity for networking and learning from others was outstanding and members and non-members capitalised on the chance to raise issues and concerns from their experiences.

The program of presentations on the first two days provided a diverse range of papers around the four themes: (1) Extreme policy changes, (2) Urban ecology, (3) Using revegetation to achieve ecological outcomes, and (4) Indigenous interests in conservation; several of these papers are summarized in this issue of APC. A keynote address by a prominent leader in the field opened up each theme and set the scene for the contributions which

followed. In most cases the keynote speaker aroused some controversies and provoked healthy debate.

The third day saw the majority of participants take part in a field trip to the Adelaide Hills and particularly to Scott Creek Conservation Park where they were able to view first hand and to learn from the results of volunteers driving a major restoration effort.

Friday September 29 supported a number of concurrent workshops covering different issues associated with plant conservation, including analysis of techniques for assessing vegetation, grass identification, weed risk assessment, managing small patches in urban areas and effective communication strategies. By all accounts participants found this format of short targeted workshops led by experts to be extremely rewarding and helpful for their own circumstances.

On the final day of the conference ANPC ran another of the Translocation for Threatened Plants workshops. The real examples and scenario considerations seem to be a proven format to successfully have practitioners consider the issues of translocation and to assess the feasibility of success and options that may be pursued to reach positive outcomes.

From the big picture point of view there were a few take-home messages from the conference and workshops. The inclusion of monitoring and review processes in any conservation and restoration project is paramount – besides learning from past experiences, in many cases an iterative approach has resulted in far better outcomes than if the initial methods had been left to run their course. There is a clear need for baseline information to be available to on-ground practitioners and some responsibility for those researching and providing such knowledge bases to enhance accessibility. A sobering point concerning any plant conservation effort is the length of time required by the nature of the work – it is important to recognise from the outset that any such project requires long term planning and to incorporate that into the expected outcomes. To assist others in their approach to monitoring of revegetation projects it may be useful to set up a range of examples at varying scales and in diverse plant communities to illustrate applicability



*Mark McDonnell spoke on the role of ecological research in conserving urban biodiversity. Photo: ?*



*Panel discussion for 'Using revegetation to achieve ecological outcomes' symposium session. From left to right: Denis Saunders, David Carr, Ivan Clarke, Ross Oke, Rick Davies, Grant Wardell-Johnson and Paul Gobson-Roy. Photo: ??*

of different methodologies. During the conference several projects were presented that would provide excellent examples for such an initiative.

ANPC has been busy on the workshop front in the past couple of months as well, including further translocation workshops in New South Wales; all were very well attended. Our expertise in running these translocation workshops resulted in an invitation to expand the content and to run a similar program in India – see report elsewhere in this issue.

Our Project Officer Sally Stephens has organized more rehabilitation workshops in regional New South Wales. Following the Armidale workshop in July, two others were held at Wagga Wagga and Dubbo, the latter followed by a grass identification techniques course. The feedback from participants of these workshops has been extremely positive and indicates the need for this sort of assistance in undertaking restoration and ecological rehabilitation management activities. A report on this series of workshops is included in this issue.

With many of the ANPC committee attending the meeting in Adelaide we took the opportunity to get together a couple of times to discuss the more strategic directions of the Network. Included was some discussion on the efficacy of these ANPC national conferences and whether we should continue in this format, or to try

some other style of meeting to generate ideas and discussion on issues relating to plant conservation. One outcome of our deliberations was the idea of trying a different style of meeting, perhaps in the form of a forum one-day topic (perhaps the “ANPC Annual Forum”) together with one day of workshops. The large number of science and conservation related meetings around Australia now provides a greater challenge to hold a meeting that will attract the mix of conservation interests that has always been ANPC’s remit. If you have any comments or suggestions as to future meetings or topics for a one-day forum please don’t hesitate to contact any of the Committee members or myself.



*Conference participants enjoying morning tea. Photo: ??*



# Sharing experiences and expertise: ANPC contributes to a workshop on plant translocation in Pune (India)

*Maurizio Rossetto*

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Botanic Gardens Conservation International (BGCI) as part of the 'Investing in Nature' programme funded by HSBC, organized a National Workshop in Pune (India) entitled 'Plant Translocation – enriching India's flora by returning rare plants to nature' in September 2005. BGCI brings together the world's Botanic Gardens to form a community working in partnership to achieve global conservation and education goals. One of its main aims is to use its cumulative knowledge to advise governments on the importance of plant conservation and to raise awareness on this critical issue.

Developed with the National Botanical Research Institute (NBRI, Lucknow), this workshop examined the question of plant translocation and created a discussion forum for assessing risks and requirements of this conservation approach. Following from the success of the 'Guidelines for the Translocation of Threatened Plants in Australia' published by the ANPC, and of the national workshops that ensued, three of the authors Maurizio Rossetto (Botanic Gardens Trust), Tricia Hogbin (NSW Department of Environment and Conservation), and Leonie Monks (Department of Conservation and Land Management, WA), were invited to share their expertise and facilitate the Indian meeting.

The meeting was based on ANPC's workshop, but was extended to four days to allow enough time for the presentation and discussion of local case studies. The objective was to present and describe the practical and theoretical approaches needed for successful translocations of rare plant species. A particular emphasis was on the importance of scientific design, monitoring and long-term commitment to conservation and management projects.

The ANPC guidelines were developed on the back of over 10 years of practical experience and scientific trials. In comparison, although more recent, the Indian experience involves concerns that are not often shared with Australia. For instance, a range of social components relating to the use of rare species as non-commercial

sources of food and/or medicinal products are not common to our experience. The social benefits from these plants increase pressure on their survival but also create a sense of urgency and respect in relation to their long-term conservation. As a consequence, these plants are often reintroduced within a forestry or agricultural framework that does not necessarily consider the full extent of issues relevant to the long-term survival of these species within their natural habitat.

The range of local studies was extremely informative and included experiences ranging from orchids to mangroves, and from rainforest trees to gingers. The workshop also included a one day visit to the north-western Ghats, one of the world centres of biodiversity. This area of high diversity has been impacted by intensive human usage for many centuries. As a result, here as in other parts of India, many of the areas of conservation significance are sacred sites ('sacred forests') protected by the local communities rather than by the government. These sites are dedicated to a specific deity and are left in relatively pristine conditions, although pressure for development is increasing, particularly for smaller sites in proximity to urban areas.



*The participants to the plant translocation workshop organised in Pune (India) by BGCI, and presented by a panel of rare flora translocation experts from the ANPC.*

Overall it was a successful meeting and the feedback from all participants was very positive. This workshop was an opportunity to showcase the excellent flora-conservation work conducted within Australia and disseminated so successfully by the ANPC, and to learn from international experience. The possibility of conducting similar workshops in other part of south-eastern Asia as a collaborative effort between ANPC, BGCI and external funding bodies is being discussed.

*Visit to a 'sacred forest' in the Western Ghats, a small temple at the centre of the site is pictured. These sites of significant biodiversity relevance bring together spiritualism and conservation.*

*Photo: Tricia Hogbin.*



## ANPC rehabilitation workshops in regional NSW - 2005

*Sally Stephens - ANPC*

We're now drawing breath after completing a series of workshops focusing on ecological rehabilitation of disturbed native vegetation, held in regional centres of inland NSW.

The first in the series was on montane restoration, held in alpine areas of the ACT and southern NSW on 28-30 April 2004. Three more workshops were held during 2005, in Armidale (19-20 July), Wagga Wagga (14-15 September) and Dubbo (25-26 October).

A core group of presenters contributed to the full workshop series, explaining and demonstrating fundamental principles underlying ecological restoration. Other topics included: planning a rehabilitation project, ecological stability and degradation thresholds of plant communities, the role of soil-symbionts, rapid assessment of soil health, genetic research relevant to the perennial provenance debate, roadside vegetation management, review of remnant fencing projects, monitoring, evaluation and adaptive management.

Preliminary sessions provided updates on reforms and changes to native vegetation and threatened species legislation, and the local Catchment Management Authorities (CMAs) gave overviews of their goals for native vegetation and current implementation activities.

Presenters from the workshop regions and beyond added a diversity of experience and covered a range of issues. Presenters included staff from government agencies, local Councils, environmental consultants, Landcare groups and industry. The participants also came from such groups, as well as other interested land-managers and individuals.



*Discussing past and future management at Snow Gums Bushland Reserve, Armidale. Photo: Sally Stephens, ANPC*

### Learning from experience

Some case studies drew on projects re-visited after 40 years, such as some alpine restoration work undertaken during the early 1960s, when 'ecology' was a brave new word. Lessons learnt from these and later experiences have improved current rehabilitation practice, and shown the necessity of an ecologically sound approach. Local case studies demonstrated hardships, successes, the need for persistence and our dependence on the dedication of volunteers.

### Pines to bush

The workshop included an afternoon activity, with the participants working in groups, applying ecological principles to plan the conversion of a harvested pine plantation back to a functioning native vegetation community. As this had been

a real project, the participants benefited by hearing what had REALLY been done and what had been learnt subsequently.

### Field visits

Field visits to local sites gave opportunities for exchanging ideas and experiences, raising and discussing issues, quizzing specialists, seeing techniques demonstrated, such as assessing soil health or site condition, debating initial approaches and ongoing management, testing assessment techniques and networking, networking, networking.

### Going grassy!

The ANPC made its first foray into teaching grass identification techniques, with a one-day course following the Dubbo rehabilitation workshop. The Ibis Room at Western Plains Zoo was filled with 48 eager participants. After introductory sessions on grass morphology and terminology and the use of keys, the participants broke into eight groups, working with tutors and using stereo microscopes, laptops loaded with the CD-ROM *AusGrass*, published keys (particularly *Grasses of NSW* and *Flora of Australia* vol 4), hand-lenses and dissecting needles. Swathes of grasses filled the room and their floral parts were examined minutely to reveal their taxonomic secrets.

The groups also looked at grasses growing around the zoo to learn field characteristics. Towards the end of the day, one eager group set off again, returning hot and tired, but still enthusiastic.

We were lucky to have one of the two authors of *AusGrass*, Donovan Sharp, journey all the way from the Queensland Herbarium to lend his expertise to those unfamiliar with this interestingly intuitive identification method. All the 'grassy gurus' provided invaluable guidance and teaching, and had no chance to sit back and relax, as did presenters at the rehabilitation workshops!

### How many came?

An unexpected 105 people attended the Armidale workshop, coming from as far afield as Queensland, Walgett and the Blue Mountains. These numbers exceeded our experience in running workshops in regional centres; the Namoi Catchment Management Authority partly contributed by viewing this as an important training opportunity for staff.

At Wagga Wagga we had 40 attendees, with one coming from Adelaide; others came from Victoria, Hillston, Sydney and the central coast. Despite a last-minute announcement of a clash with a related workshop on exactly the same days,



*David Tongway demonstrates his LFA technique for assessing soil health at Silvalite Reserve, Wagga Wagga. Photo: Sally Stephens*

49 attended the Dubbo rehabilitation workshop and 48 came to the grass identification course (28 of whom were at the preceding rehabilitation workshop).

### Accreditation

Since late 2004, the ANPC has been able to offer accreditation contributing towards Conservation and Land Management Training Package diplomas and certificates, as our workshops provide knowledge underpinning a range of CLM units. Of the total of 214 participants at the 2005 workshops, 89 sought accreditation (= 41.6%).

### Evaluation

The evaluation forms have still to be fully analysed, but the responses were overwhelmingly positive, with

consistently high scores on the evaluation sheet questions. One participant, quite unsolicited, announced 'this is the best workshop I've ever attended!' Constructive comments were also provided to assist with future workshop planning. Of course, it's impossible to fit everyone's wish list of topics into a two-day workshop.

### Acknowledgements

Many thanks to all who generously gave their time and expertise: the presenters and tutors, our volunteers and all who helped with field site planning. Thanks also to all the agencies, organisations and Councils who assisted, as well as to those organisations who generously lent resources required for the grass course.

Without you all, these workshops would not occur! Our goal is to now take similar workshops to areas not yet visited!

**This project has been assisted by the NSW Government through its Environmental Trust**



*Thinning of *Callitris* regrowth undertaken at the Western Plains Zoo Sanctuary – a topic of discussion at the Dubbo workshop. Photo: Sally Stephens*

# Towards a Landscape Conservation Culture: anticipating change in the Tingle Mosaic, south-western Australia

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## Introduction

The Tingle Mosaic in south-western Australia includes the wettest and least seasonal part of Western Australia, and harbors an extraordinary diversity of vascular plants, including five species of forest eucalypts endemic to the local region. The co-occurrence of three of these species, commonly known as tingles (Red Tingle—*Eucalyptus jacksonii*, Yellow Tingle—*E. guilfoylei*, and Rates Tingle—

*E. brevistylis*), in an area noted for a variety of vegetation types prompted the name 'Tingle Mosaic' (see Wardell-Johnson & Williams 1996). The Tingle Mosaic has long been noted for its outstanding biodiversity values and also has a considerable history of scientific and public interest.

In this paper we introduce the idea of a Landscape Conservation Culture as a new management planning philosophy for the Tingle Mosaic. The approach is being developed through an Australian Research Council Linkage Grant between The University of Queensland, The University of Western Australia and the Department of Conservation and Land Management (CALM).

## Disturbance, management and research

CALM has overall responsibility for the management of public lands and for the conservation of the state's biota. CALM's mission provides commitment to science-based adaptive management, which includes important components such as evaluation of alternative management regimes and the ability to vary management prescriptions in the light of evidence.



The Tingle Mosaic in south-western Australia encompasses the distributions of five locally endemic forest eucalypts. Top, left to right: (a) *E. guilfoylei*, (b) *E. brevistylis*, (c) *E. virginea*, (d) *Corymbia ficifolia*. Photos: G. Wardell-Johnson.



Clearing, fragmentation and introduced pests and disease have had major impacts in the Tingle Mosaic. The region is also exposed to biotic disturbances (e.g. from *Phytophthora* spp), and fire management there remains contentious (see Burrows & Wardell-Johnson 2003). Several large-scale high intensity wildfires in the region's recent history have prompted examination of alternative fire management strategies.

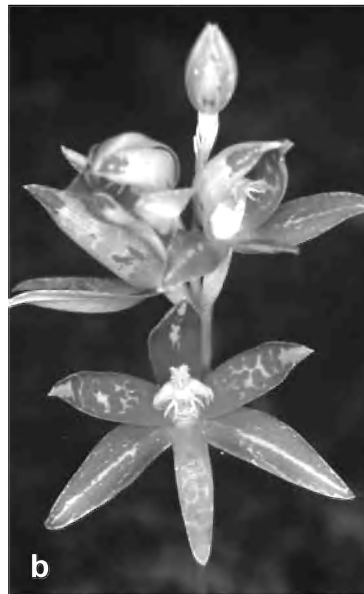
CALM has recently proposed implementation of a pilot fire mosaic project in the proposed Walpole Wilderness Area (which approximately coincides with the Tingle Mosaic). The project's aim is to use the planned and frequent introduction of fire into the landscape to create a fine-grained mosaic of interlocking patches of vegetation at different stages of post-fire development. Although management assuming a fine-scale mosaic has been advocated (Wardell-Johnson & Horwitz 2000), the efficacy of this approach for the biota has yet to be quantitatively assessed. The reality and stability of vegetation boundaries under different regimes of disturbance is also yet to be determined in south-western Australia.

### Management in a Landscape Conservation Culture

The complexity of conservation management implied by the fire mosaic project, together with the many rare and threatened species and ecological communities in the region, highlights the need for a new approach to ecosystem planning. It will require a change from single species and ecological community recovery plans to multi-species, multi-community ecosystem planning in an adaptive management framework—a change towards management within a Landscape Conservation Culture.

This new approach will rely on:

- an integrated framework to interpret knowledge about natural landscape processes;
- the synthesis of data obtained through biological surveys (at a plot scale) and remote sensing (landscape scale), with spatial data handled through geographic information systems;
- an explanatory modelling approach to test ecological theories and current and proposed conservation policies that interpret data and make model-based predictions of species and assemblage distributions under different disturbance scenarios; and
- a committed and engaged local community.



The Tingle Mosaic is noted for a variety of vegetation types (a) and an extraordinary diversity of vascular plants, including several local endemics such as *Thelymitra jacksonii* (b) and *Cephalotus follicularis* (c).

Photos: G. Wardell-Johnson.

### The research program

The program will draw on extensive floristic and environmental data from several hundred permanently located quadrats in the Tingle Mosaic that were assessed between 1988 and 1992. These data provide an opportunity for integration to define the mosaics within which the CALM fire management project is to be implemented. A digital elevation model to be constructed at a 5 m scale will allow the use of the floristic and environmental data for predictive modelling at various landscape scales. This will allow evaluation of innovative operational fire management and disease spread prevention programs. It will be possible to predict whether different approaches to the management of disturbance are likely to influence biodiversity outcomes.

The program includes two research projects. The first involves developing a model of the floristic composition of the Tingle Mosaic and examining the relationship between functional landscape descriptions and observed spatial and

temporal landscape patterning. It will involve simulations aimed at discovering the best match between observed patterns and functional descriptions of landscapes. Spatial analysis of observed abiotic and biotic data will also be carried out to find the best explanation of ecological processes that produce observable landscape patterns in the Tingle Mosaic.

The second project involves developing and testing alternative species models to predict the distributions of five locally endemic forest eucalypts—the three species of Tingle plus *Eucalyptus virginea* and *Corymbia ficifolia*—and to develop further knowledge of their ecology. Because they are relict taxa within refugial environments (Wardell-Johnson & Coates 1996), climate change may impact their future conservation status which in turn will impinge on the conservation of the assemblages with which they are associated.

Existing quadrat-based environmental and demographic data and distributional data on these species will be used in an explanatory modelling framework to explain spatial variation. Potential changes to distribution and conservation under different changed climatic scenarios will be examined, and other critical or related species may be investigated, and implications for species co-occurrence and future protection considered.

### Conclusion

Management efforts to address biodiversity concerns need the support of appropriate ecological theory and empirical evidence of a requirement for change. The approaches being tested in the Tingle Mosaic, including the development of area-class maps at different spatial scales (a considerable

innovation over maps depicting homogenous discrete zones) and a regional model of compositional gradients, will facilitate more explicit land management decisions which can be effectively monitored and will allow alternative disturbance regimes for biodiversity conservation to be tested. This will enable a management and policy change away from management based on stable and permanent biotic assemblages and boundaries in conservation reserves. The result may be the development of a Landscape Conservation Culture.

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## The Grassy Groundcover Research Project – returning complex indigenous grassland communities to agricultural land

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The purpose of the Grassy Groundcover Research Project (GGRP) is to use direct sown seed mixtures to reintroduce complex and persistent grassland communities to agricultural lands. This project stems from and furthers the scope of a series of restoration studies conducted at the University of Melbourne's Burnley Campus over the last several years. This work investigated the use of multi-species seed mixtures to reinstate functional and persistent grassland communities via direct seeding. Results from this

earlier work indicated there was considerable potential for broad-scale restoration of herbaceous plant communities using direct seeding. (Gibson Roy, Delpratt *et al.* 2004).

The GGRP is a three-year experimental project funded by the National Heritage Trust and sponsored by several southwestern Victorian Catchment Management Authorities. It is managed in partnership by The University of Melbourne and Greening Australia (Victoria).

The focus of the GGRP is twofold:

- to investigate the techniques required to reintroduce multi-species assemblages (representative of locally occurring remnants) onto land with an agricultural history (where weed management and seedling establishment are primary areas of experimental interest);
- to investigate the production of large quantities of high quality provenance seed in containerized production systems.

The project was initiated in November 2004 and is headed by Dr Paul Gibson Roy. Experimental locations range from Bendigo in the state's central region to Colac in the south, and from Hamilton in the west and Minyip to the north. The project has to-date sown the first of three annual sowings at each of fourteen one hectare experimental sites across southwestern Victoria. Initial surveys of sown plots one month after sowings indicate good germination response thus far (Figures 1 & 2). These sowings followed a first season's seed collection that was probably the largest single provenance-based collection of indigenous species undertaken for such restoration purposes (approximately 180 to 200 species).

The production of seed to supplement field collections for second and third year sowings has been initiated at six seed production facilities linked to each of the sowing sites. Plants from the range of species collected from remnant communities have been propagated by growers and grown as seed crops for harvest in 2005/06 in a containerized production system (Figure 3). To-date 27,000 plants have been propagated and are now growing in 1350 boxes across the six growing sites for provenance-based seed production.

The GGRP is entering the second of a three year program. Encouraging results have been delivered in terms of establishing multiple, site-specific, seed production facilities to supplement field collections and in terms of early counts of field emergence from each of the 14 direct sowing experiments. However, seedling establishment, recruitment and weed competition remain important components of experimentation in the remaining years of this project.

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*One of fourteen one hectare sowing sites established through the Grassy Groundcover Research Project. Seed are being sown onto experimental plots as part of the first years sowing program.  
Photo: Paul Gibson Roy*



*Early seedling emergence at one of the experimental sites. Photo: Paul Gibson Roy*



*An example of the box system for growing plants for seed production used in the Grassy Groundcover Research Project. This seed production site is managed and run by the Geelong Botanic Gardens. Photo: Paul Gibson Roy*

# The role of revegetation in landscape conservation

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## Introduction

The patchwork landscape that presently exists across the Greater Adelaide Region is testament to the intensity and impact of European settlement over the past 175 years. The introduction of agricultural systems and rapid urbanisation has resulted in the widespread clearance and modification of over 90% of Adelaide's original native vegetation. The landscape and associated natural systems now exist in a fragmented mosaic of habitat and non-habitat at varying levels of modification. Faunal diversity has been reduced significantly and further extinctions are predicted.

It is now widely accepted that biodiversity conservation requires more than just maintaining the least modified fragments to preserve ecosystem function and landscape condition. Improving, buffering and connecting fragments, according to the state of landscape alteration, are all actions required to halt and potentially reverse further degradation (McIntyre & Hobbs 2000).

## The SA Urban Forests–Million Trees Program

The Million Trees Program is a major revegetation initiative of the South Australian Government and is delivered in conjunction with the SA Urban Forest Biodiversity Program. The combined SA Urban Forests–Million Trees Program ('The Program') provides a focus on remnant vegetation conservation and strategic, appropriate revegetation for biodiversity and educational objectives.

The Program is dedicated to planting three million local native trees and associated understorey species throughout the Adelaide Metropolitan open space system by 2014. This includes a commitment to restore at least 2000 hectares of local native vegetation and achieve multiple environmental/natural resource management outcomes.

The Program works with all project partners to significantly enhance Adelaide's urban and suburban environments with additional habitat for flora and fauna, and improved air and water quality. It is in a unique position to identify, prioritise and assist with the implementation of appropriate management activities within the varied landscape of the Adelaide region. By analysing the level of landscape alteration and using existing knowledge bases, key actions have been identified to guide the nature and level of investment required in key landscapes.

## Setting a goal for landscape conservation in Adelaide

To set clear targets for landscape restoration, The Program used a combined rehabilitation and revegetation approach. The Greater Adelaide area was divided into regions using the Environmental Associations of Laut *et al.* (1977) (see Table 1), to enable individual sub-regions to be studied at a closer level and general conservation issues to be identified. Table 1 shows that for many environmental associations, the proportion of remaining vegetation is well below the optimum proportion (30% of all habitat types protected or restored) required to sustain bird populations in the region (Possingham & Field 2000). Revegetation is thus an essential tool in restoring this landscape.

Table 1. Environmental Associations within Greater Adelaide

Name	Size (ha)	% remaining vegetation	% remaining vegetation legally protected
Adelaide Foothills	16,072	1.0	32
Aldinga	26,416	1.8	36.1
Bare Hill	13,129	11.2	16.2
Clarendon	28,050	28.7	23.6
Mallala	189,017	3.4	0.6
Mt Terrible	17,093	33.5	31.3
Mt Wilson	15,284	1.7	0
Parham	41,398	48.7	2.5
Reedbeds	12,842	0.1	0
Rosedale	32,888	2.6	7.6
Uraidla	14,376	2.1	8.1

The Program aims to:

- Protect and / or restore all the habitat types that originally (pre-clearance) occurred throughout Greater Adelaide.
- Conserve or restore (through revegetation or rehabilitation) 15% of all habitat types to maintain ecosystem function throughout time.
- Recognise that across the region there will be variations in habitat types and protect these regional variations.
- Contribute to National and State Conservation initiatives by identifying, protecting and restoring habitats and species of conservation significance.

Setting the preservation goal at 15% (cf 30%) recognised the many constraints in the urban area, including available land, the large range of stakeholders and widespread commitment for conservation projects.





Establishing a vegetation buffer to Aldinga Scrub Conservation Park, Southern Adelaide, S.A. The "Before" photo (left) was taken in January 2002 and the "After" photo (right) was taken in January 2005.

### Turning the goals into actions

A broad map of pre-European vegetation distribution and a map of current distribution are a minimum requirement to accurately turn these goals into actions. This information is available for metropolitan Adelaide due to the comprehensive vegetation surveys and analysis already undertaken. Whilst some areas, particularly on private land, are still not extensively surveyed or mapped, broad-scale vegetation information has been sufficient for project planning purposes.

To help prioritise on-ground management actions, each Environmental Association in Greater Adelaide was assigned a condition class (see Table 2) based on its remaining vegetation and the condition of the landscape. No Environmental Association in the region was ranked as Intact.

Table 2. Landscape condition classes (after McIntyre & Hobbs 2000)

Condition class	% remaining vegetation	Conservation focus
Intact	Less than 10% of vegetation destroyed	Maintain condition and complexity of landscape; improve patches and connecting areas
Variegated	Between 10-40% of vegetation destroyed	Maintain condition and complexity of landscape; plant buffers/connecting areas and patches where appropriate
Fragmented	40 –90% of vegetation destroyed	Maintain least modified areas; aim to improve, buffer and connect remaining fragments
Relictual	>90% of vegetation destroyed	Improve and buffer fragments

### Case Study: Aldinga

The Aldinga Environmental Association is highly modified and only 1.8% of the original vegetation remains. It includes seven distinct habitat types of State/Regional conservation significance.

Although pre-clearance vegetation mapping suggest that the region once supported a wide diversity of habitat types, today 36.1% of the remaining vegetation is found within Aldinga Scrub Conservation Park. The region is thus classified as Relictual and priority actions should include improving and buffering these remaining fragments.

Revegetation of large blocks will be essential in rehabilitating this landscape to preserve or recreate 15% of all its habitat types. Protection and rehabilitation of the seven habitats of State/Regional significance is considered a priority.

Areas of remnant vegetation have been identified and targeted for rehabilitation works. Opportunities for revegetation have also been highlighted, planned and implemented with a focus on buffering and linking these small patches of vegetation, particularly where habitats of conservation significance exist.

Conservation projects to be undertaken in specific localities in 2005–06, many in partnership with local stakeholders, include:

- targeted weed control within remnant vegetation, including within communities of conservation significance
- rehabilitation and/or revegetation of coastal dunes, riparian areas and priority woodland and open forest communities (includes reserves, roadsides and private land and some areas >150 ha in size)
- fencing; access control.

Data collected from photo-points, survival rates, vegetation and fauna surveys will be analysed for ongoing monitoring, review and management decision-making.

The approach used for Aldinga provides a basis for objective decision-making relating to project funding applications/approvals and targeting major projects for the best biodiversity outcomes. It also assists in providing a focus for conservation efforts of the wider community and individual community groups.

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# Plant conservation in an urban area – Biodiversity work in the City of Burnside

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The City of Burnside is a municipality to the east of the City of Adelaide. It consists largely of suburban development but includes some steep and degraded land with larger allotments in the foothills of the Mount Lofty Ranges. Most of the native vegetation in the municipality had been cleared by 1860 for agriculture and mining.

In 1997, in response to concern about loss of trees and vegetation in the district, Council commissioned a study of the significant trees and vegetation of Burnside. Amongst other things, the study documented native flora on public and private land and provided an action plan for biodiversity conservation and enhancement in the municipality. The Biodiversity Action Plan aimed to conserve all remnant native vegetation on public land, to encourage the conservation of native vegetation on private land and to propose urban sites that could be developed as habitat.

Implementation of the Biodiversity Action Plan began in 1998 at the relict Grey Box (*Eucalyptus microcarpa*) woodland at Beaumont Common, with work beginning on the protection and restoration of the most diverse patches of native grassland flora and the stabilisation and revegetation of the creek.

Work at many other sites began in 1999, when Council formed a small biodiversity field team based at the Council nursery. Work sites were identified in the Biodiversity Action Plan as having the highest priority for conservation or revegetation. Work at these sites also had to be acceptable to nearby residents. In urbanised areas where land values are high and residents have little connection with the natural environment, it is a challenge to identify areas where people will accept local flora.

Two areas of private land identified in the study as containing native vegetation have now become council reserve land through negotiation with the owners and land purchase. Most undeveloped urban native flora sites have, however, now been cleared for development. Prior to development, field staff rescue whatever flora can be



Beaumont Common – a place for local flora area in an urban park. Photo: Andrew Crompton

salvaged and allow it to recover in the nursery before subsequently returning it to a safe location. This is no substitute for in-situ conservation but it does enable populations of some species to survive and has provided material for propagation.

Work sites in established urban areas present particular difficulties, such as the restoration of very degraded native vegetation in which 95% of the biomass consists of weeds, and the revegetation of creek-lines subject to massive urban stormwater runoff. Vegetation work is based on the following principles:

- All naturally occurring indigenous flora is conserved
- All weeds are removed
- All plantings to be local provenance and appropriate to site
- Natural regeneration is fostered
- Records are kept of species present and the provenance of plantings
- Work starts in areas of best condition and moves outwards
- Un-worked areas are managed with a brushcutter and major weeds are controlled
- Vegetation is cut, pruned and edited to satisfy urban aesthetic requirements.

These principles are consistent with the Bradley Method (J. Bradley 1988) developed in Sydney and now used throughout the world. We modified the Bradley method to take account of the degraded nature of our sites and to satisfy the aesthetic requirements of our residents.

The biggest problems for plant conservation in urban areas are social rather than technical. We have had to learn to manage the public dislike of the seasonality and the perceived lack of colour and diversity in local native flora. We also work with residents who love all trees and value a fast growing invasive Aleppo Pine (*Pinus halepensis*), more highly than a small slow growing native pine (*Callitris gracilis*). Urban sites are managed so that the aesthetic taste of urban residents is not severely challenged and so that vegetation change is gradual. It is a rare site in an urban area that can be managed purely for conservation and habitat. Management for aesthetic and recreational outcomes can still be consistent with plant conservation and the maintenance of ecological function.

As well as a gradual approach to vegetation change, we recognise the importance of education. Whilst urban

biodiversity sites cannot be compared in diversity and habitat value to major conservation parks, their value in exposing and eventually connecting urban people to the natural heritage of their area is inestimable. As resources become available, we install interpretive signage, produce brochures and invite councillors, staff and residents on inspections of biodiversity sites in the municipality.

One day we may have areas of restored woodlands with viable populations of the original native flora, linked by vegetated corridors along creek-lines. This vision can only become reality with the support of a knowledgeable and aware population. Unfortunately, with all the conflicting demands of a modern urban population and the realities of local politics, it is unlikely that any local authority will ever have enough resources to achieve a perfect local plant conservation program. The key is to know what is the most important and where not to compromise.

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## Bushcare beyond Bradley: A case study for weed control in urban habitats

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### Introduction

Weeds are increasingly invading Adelaide's fragmented urban bushland. As with all plants, weeds have preferred growing conditions, growth forms, reproductive techniques and habitat requirements. Subsequently weeds can impact on indigenous plant species in a variety of ways and at different rates.

Historically "bushcare" weeding techniques have focused heavily on the Bradley Method: that is removing weeds from the best or core areas of habitat and working from there towards the edge. The Bradley Method is suitable for small-scale control efforts but less applicable on a regional or large local scale. As information and techniques evolve it has become necessary to consider the impact of weeds on a regional and local scale and prioritise control programs to suit.

### Prioritising Weed Control

It has long been accepted in conservation work that available resources will fail to meet requirements and conservation programs have therefore adapted by prioritising their efforts. Weed control or eradication is one of the greatest users of limited resources. By understanding how individual species of weeds operate in a landscape, control programs can be

tailored to address the threats in a systematic fashion, maximising outcomes for the available dollars.

The Bradley Method was developed to eradicate weeds from small urban patches of bushland. The main objectives of this method involve selecting the core or best area of bushland and working in a methodical direction from the core bushland area towards the more degraded areas. Weed control techniques use minimal disturbance methods and the speed of weed control is governed by the rate of indigenous plant regeneration. While the Bradley Method is still used, and can be relevant in bushland management, using this method alone fails to recognise the biology of individual weed species or regional threats. The Bradley Method can be labour intensive and time-consuming and a number of selective herbicides have been developed since the Bradley Method was introduced which can accelerate control programs, create less disturbance and provide better cost effectiveness.

To develop a smarter weed control strategy it is suggested that core areas are still identified and protected but integrated into a larger program. Volunteers are directed to more intact areas where their valuable time will be well spent with skilled contractors being engaged to execute the additional work.

### Weed Prioritisation Criteria

The following criteria have been developed by Kieran Brewer and have great application across many regions. They do however require regional adaptation based on local knowledge. The advantage of these criteria is that they can be used at both a regional and site level depending on the nature of the surrounding landscape or scope of the project.

#### Criterion 1: Size of Population

- Identify and map individual weeds in the region or site to illustrate the extent of the species distribution.
- Weeds that are small in number and distribution are a high priority to eradicate regardless of their location in the landscape.
- It is extremely efficient to eradicate a weed species if there is an opportunity.

#### Criterion 2: Accessibility

- The ease of access to a weed or population of weeds may have a large bearing on associated costs.
- Program managers must consider the trade-off between a large investment in removing weeds from a costly and time consuming area verses the outcomes from removing weeds from an easily accessed area.

#### Criterion 3: Potential for Success

- This can often be highly subjective and dependent on the available human resources to undertake a task.
- When prioritising a weed control program, the likelihood of successful control must be considered given the level of investment and skills of the operator undertaking the work.
- Other considerations may include the techniques available for control given the proximity of water or off target species and timing of the works.

#### Criterion 4: Colonising Potential

- An understanding of the biology of the weeds within the region or site is essential in making informed management decisions.
- Action should seek to target weed species that have a rapid rate of dispersal and / or have the ability to colonise relatively intact areas.

#### Criterion 4: Suppressive Characteristics

- Weeds species threaten biodiversity through suppression and competition for available resources.
- Weeds can suppress indigenous plants through changing soil pH, shading and weed density.
- Some weed species are particularly effective at competing with indigenous plant species and need to be controlled as a priority as it is these species that will have an immediate effect on biodiversity.

#### Criterion 5: Regional Distribution

- Although a project site may be small, it is important to consider the impact of the work within the region.
- Any weed species that is restricted to a site or not common elsewhere in the region should be controlled as a priority or before it is given an opportunity to spread further.

#### Criterion 6: Threat to species or associations of conservation significance

- It is important to consider the broader implications of protecting regional, state or national species of conservation significance.
- Investment in protecting these species or associations will contribute to biodiversity conservation on a larger scale.

#### Criterion 7: Position in Landscape

- Where opportunities exist, weed control programs should take advantage of landscape characteristics.
- This may include removing weeds that are at the top of a catchment to avoid them spreading downstream or removing weeds that can be dispersed by wind from exposed areas.

### Case Study: Norton Summit

The Norton Summit Region is in the central Adelaide Hills and is part of the River Torrens Catchment. The area is relatively well vegetated and contains Morialta, Montacute and Horsnell Gully Conservation Parks and a large amount of remnant vegetation located on private land. Conservation projects have targeted this region due to large blocks of remaining vegetation including parcels under formal protection, the presence of rare and threatened habitats and species, and the dedication of the local community. Project partners have included National Parks and Wildlife, Adelaide Hills Council, local residents and the Fourth Creek Catchment Group.

Regional surveys identified habitats and individual species of conservation significance as well as noting and mapping weed populations. Whilst undertaking this process the weed *Muraltia heisteria* was identified as a regional concern. *Muraltia* has many of the characteristics that make a weed a priority for control or eradication. Within Norton Summit *Muraltia* is currently in relatively small patches, has the ability to colonise areas including intact vegetation, has the potential to flower all year and for the seed to survive in the soil for long periods, it is not known in other areas of the Adelaide Hills and is currently threatening habitats of conservation significance.

Eleven private properties containing remnant vegetation along the upper reaches of the Fourth Creek Catchment were also surveyed in detail to identify plants of conservation significance and set a prioritised program of weed control. Each property was treated as an individual unit to assist the land owner in managing their own property, however



consideration was given in the weed control program to the removal of high priority weeds for the region. These properties contain over 120 hectares of remnant vegetation with 211 indigenous plant species being identified to date.

One of the smaller sites - Alistair Black's property has around 5 hectares of native vegetation, containing 131 plant species of which three are of conservation significance. The vegetation survey and management plan undertaken by Kieran Brewer also identified 14 weed species that are of a priority to control.

Two maps have been supplied to illustrate the importance of undertaking a prioritised approach to weed control. Map One highlights the distribution of the plants of conservation significance. If a Core area were to be selected, it would appear that the centre of the property, near the riparian area would be a logical choice. It is this area that contains the most intact vegetation and plant species of conservation significance.

Map Two depicts the top three weeds for control.

#### Priority 1 - Muraltia

- Although not threatening plants of conservation significance, Muraltia is the highest priority for control due to the broader issues relating to this species.
- The population is about 2km from other known populations and contains less than 400 plants.

#### Priority 2 - Broom

- Is spreading down from the top of the hill due to the exposed nature of the ridgeline. By controlling the broom on the edge of the property and containing it to the valley it is anticipated the rate of spread will be reduced.

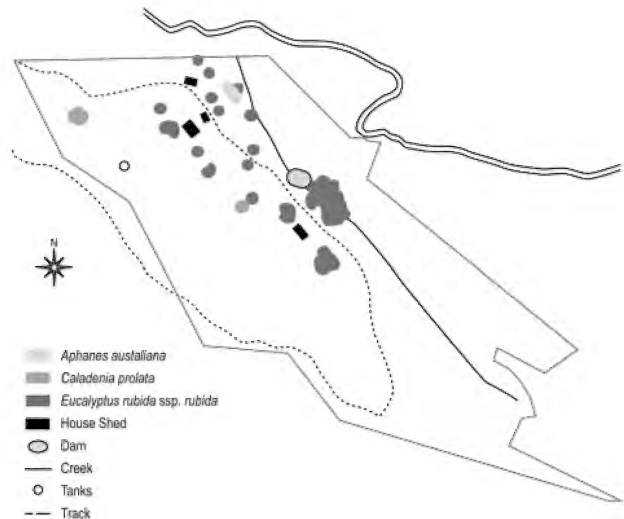
#### Priority 3 - Sour Sob

- Targeted due to its suppressive characteristics, particularly in regard to ground flora, and low potential for success if numbers increase.

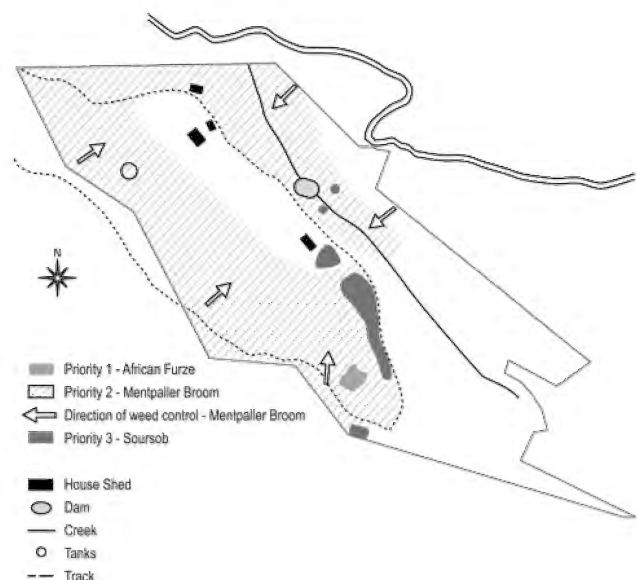
### Conclusion

To protect biodiversity from the increasing threat of weeds, control programs must be efficient and prioritised. Historical methods of working from the best areas of biodiversity towards areas of least diversity can no longer be the sole contributor to regional conservation plans. The Brewer criteria, adapted to meet each region's needs, can be used to develop and implement the best weed control strategy. This approach, in partnership with land managers and volunteers, still uses the minimal disturbance method as part of the integrated program.

The UFBP is committed to working with all land managers and project partners to address the loss of biodiversity in metropolitan Adelaide. Through directing funds to the most significant areas of habitat and tackling the key threats in a coordinated and prioritised manner, the Program aspires to protect Adelaide's biodiversity from weed invasion for long term results.



Map One: Plants of Conservation Significance Black Property, Norton Summit. The distribution of the plants of conservation significance are predominantly in the centre or core of the property



Map Two: Priority Weed Species for Eradication or Control Black Property, Norton Summit. The Muraltia has been targeted due to the regional importance of eradicating this species, the Broom will be contained to the lower section of the property through undertaking weed control in this direction and the Sour Sob has been highlighted due to the suppressive characteristics it is known to have, particularly on ground flora.

### Acknowledgement

The intellectual property contained within this paper belongs to Kieran Brewer of SA Indigenous Flora. Kieran's extensive knowledge and management experience in conservation in South Australia has enabled him to develop and implement some of the highest priority and quality work. The Urban Forest Biodiversity Program (UFBP) is privileged and grateful to be able to work in partnership with Kieran.

# Achieving threatened species conservation in conjunction with urban development—Roe Highway Stage 7 extension, Leeming WA

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The Grand Spider Orchid (*Caladenia huegelii*), is a Declared Rare Flora species under the WA *Wildlife Conservation Act 1950*, and is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

A population of *C. huegelii* is located in the footprint of Stage 7 of Roe Highway (Roe 7), an extension that will complete a ring road system for Perth and improve transport efficiencies for freight and general traffic. Due to the occurrence of this population, State and Commonwealth regulatory authorities set condition approvals for the Stage 7 extension that required the Roe 7 Alliance team to implement a range of measures to mitigate impacts, offset unavoidable impacts and contribute to future conservation of the species.

The Roe 7 Alliance is a partnership between Main Roads WA, Maunsell Australia, Clough Engineering and Henry Walker Eltin. The team has worked with the Environment Protection Authority, the Department of Environment, the Department of Conservation and Land Management and the Botanic Gardens and Parks Authority in WA to achieve the best possible conservation outcome for the species.

## Grand Spider Orchid

*Caladenia huegelii* is found on the Swan Coastal Plain between Perth and Capel. Recent surveys suggest that the population in the vicinity of Roe 7 is probably one of the two largest known extant populations of the species. In 2004, the Botanic Gardens and Parks Authority recorded 22 plants inside the Roe 7 footprint and 230 plants in the wider project area.

A number of biological factors contribute to *C. huegelii* being vulnerable to extinction. Spider Orchids flower in spring but are summer dormant. Plants survive by developing an underground tuber each year during the growth period (autumn to late spring). Initial survival of new recruits depends on the production of a tuber adequate to sustain the dormant individual throughout dormancy. The very specific pollinators of the species are males of a single species of thynnid wasp that are attracted by pheromones emitted by the orchids on warm days. Orchid seeds contain very little stored energy to support germination and are therefore dependent upon mycorrhizal fungi, present in the soil, to supply energy and nutrients during germination.

The preferred habitat of the orchid is well-drained grey sandy soils in *Banksia* / Jarrah / *Allocasuarina* woodland.



Declared Rare Flora species *Caladenia huegelii*.

Photo: Vanessa Yeomans.

Typically, plants tend to occur in well-shaded areas with a thicker overstorey or near the base of larger plants such as *Xanthorrhoea preissii*.

## Conservation Plan

The Roe 7 Alliance prepared a *Caladenia huegelii* Conservation and Management Plan for the population affected by the highway; Main Roads WA has committed to its implementation. The plan has been implemented during the design and construction of Roe 7 and will continue to be used during the project's operational phases.

Design modifications to minimise impacts

The following modifications have reduced clearing impacts on the orchid:

- reduction of the highway median width;
- realignment of the Principle Shared Path in the vicinity of orchid locations, to preserve a larger number of plants;
- placement of kerbing near orchid locations down slope from hydrological catchments;
- relocation of drainage sumps to maximise separation from orchid locations;
- realignment of the road carriageway partly outside the road reserve to avoid orchid populations; and

- modification of vertical alignment to minimise cut and fill batters to reduce the clearing footprint.

The Construction Environmental Management Plan (CEMP) addresses potential indirect impacts associated with construction. These include changes to surface hydrology and drainage (including nutrients and pollution), introduction and/or spread of dieback, proliferation and/or spread of weeds, increased risk of fire and alterations to vegetation composition and loss of microhabitats.

#### **Mitigation of unavoidable impacts: land offsets and translocation**

The Roe 7 Alliance is negotiating a package of mitigation and offset measures to support and potentially enhance the continued viability of *C. huegelii* within the vicinity of Roe 7 and provide information that will contribute to conservation and management of the species as a whole.

The package includes negotiating land offsets at two remote sites known to support populations of the orchid and within a series of land parcels surrounding the Roe 7 alignment. Where possible, land offsets will be placed into the Conservation Estate to ensure their long-term viability and provide a secure habitat for the species.

The Roe 7 Alliance, with expert assistance of orchid specialists from the Botanic Gardens and Parks Authority, has also commenced a translocation program for orchids directly impacted by the highway clearing footprint. Mature tubers of *C. huegelii* plants have been translocated to suitable nearby habitat, with the aim of conserving as many individuals as possible and providing information that will assist in the future conservation of the species.

#### **Research**

The Botanic Gardens and Parks Authority will also continue a substantial research program to investigate the species' biology to support effective long-term conservation following habitat fragmentation. The program is incorporating the following key areas:

- Genetic analysis: DNA fingerprinting of all plants to retain a library of the genetic diversity of the population, should reinforcement plantings be required, and to determine genetically significant individuals and populations relevant to translocation.
- *Ex situ* conservation—cryogenics of seed and fungi: seed from individual plants and associated mycorrhizal fungi essential for germination and plant development have been collected during the flowering season. Fungi were tested for efficacy (ability to germinate seed) prior to use in the research program and long-term storage.
- Propagation and tuberisation: a program to propagate and experimentally tuberise seedlings has fast-tracked production of plants for research translocations and subsequent reinforcement plantings.

- Research and monitoring of translocated adult plants: incorporates fungal baiting techniques to locate receptive sites and to optimise survival.
- Identification of the specific pollinator: research has commenced to determine key ecological requirements of the pollinator to ensure self-perpetuating orchid populations from natural pollination events, and to determine the influence of habitat fragmentation on pollinator activity and critical habitat size to maintain an intact system between pollinator and orchid.

#### **Progress to date**

Roe 7 construction is well under way. The clearing operation was completed according to a list of strict environmental specifications without incident. Translocation of dormant adult tubers has been completed according to all commitments and requirements. Data, seed and other *in-situ* material has been collected and is contributing to the ongoing laboratory research at the Botanic Gardens and Parks Authority.

Translocated plants are being monitored during the current spring flowering period. Other potentially negative factors such as weed invasion are also being monitored, and contingency plans to address them have been prepared.

The securing of land to offset impacts on the orchid populations is also currently under negotiation.

#### **Conclusion**

It is imperative that the potential impacts on *C. huegelii* of the construction and operation of Roe Highway Stage 7 are identified and managed in an appropriate way. The Roe 7 Alliance provides an example of how managers and personnel from a full range of disciplines can act as an integrated team with external stakeholders to address complex environmental issues, and achieve environmental commitments for conservation of a threatened flora species alongside infrastructure development.



*Orchid research scientists Dr Andrew Batty and PhD student Nigel Swarts carrying out the orchid translocation.  
Photo: Clayton Pritchard.*

# Municipal-Scale Conservation of Plant Species Around Melbourne

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## Introduction

Many of the plant species that appear on a state or territory's list of threatened species are secure in other states or territories, or overseas. Clearly, the highest level of protection and conservation should go to species threatened with global extinction, but there are still important reasons why governments place importance on species threatened only within their geographical jurisdiction:

- The extinction of a species from a jurisdiction represents a contraction of that species' range, and a diminution of the species richness in the jurisdiction. Both of these outcomes are undesirable under principles of ecological sustainability and biodiversity conservation;
- In some cases, there may be intra-specific genetic differences between jurisdictions, and it is desirable to conserve the full range of genetic variability;
- There is a philosophical viewpoint that we, as individuals, communities, organisations or governments, all have a duty of care to do what is within our own sphere of influence to look after the environment, and not rely on others (such as another state) to compensate for environmental deterioration due to our own inaction.

Each of these principles applies to municipal Councils as much as to states and territories. However, conservation of plant species that are threatened at the municipal level is very uncommon, compared with the state and territory level. This is despite the fact that actions to conserve biodiversity are being increasingly devolved to municipal councils, through policies such as the national and state Native Vegetation Frameworks.

The reasons why there has been so little attention to municipal-scale conservation of plant species are both historical and practical. This paper explains the importance and difficulties of overcoming those obstacles.

## Gathering of Data

State and federal governments have data, mapping and other information that provide a sound basis for assessing the

conservation status and needs of many plant species threatened at the state level. At the municipal scale, there is usually not even enough data to determine which species are locally threatened. However, this situation has been redressed in three metropolitan municipalities of Melbourne (Boroondara, Knox and Maroondah, totalling 235 km<sup>2</sup>), through investigations by the author in the past decade. As seen in Figure 1, Boroondara is a middle-suburban municipality, whereas Maroondah and Knox are peri-urban. All three include plant species of national significance, and many sites of national and state botanical significance (according to the BioSites criteria of Amos 2004).

To determine the conservation status of plant species in each municipality, extensive fieldwork was combined with all available pre-existing data to determine:

- The geographic distribution of each indigenous vascular plant species;
- Site-by-site population sizes of less abundant species; and
- Threats to each species at each locality.

Unfortunately, very little objective information is available at the municipal scale about trends in populations and distributions of plant species.

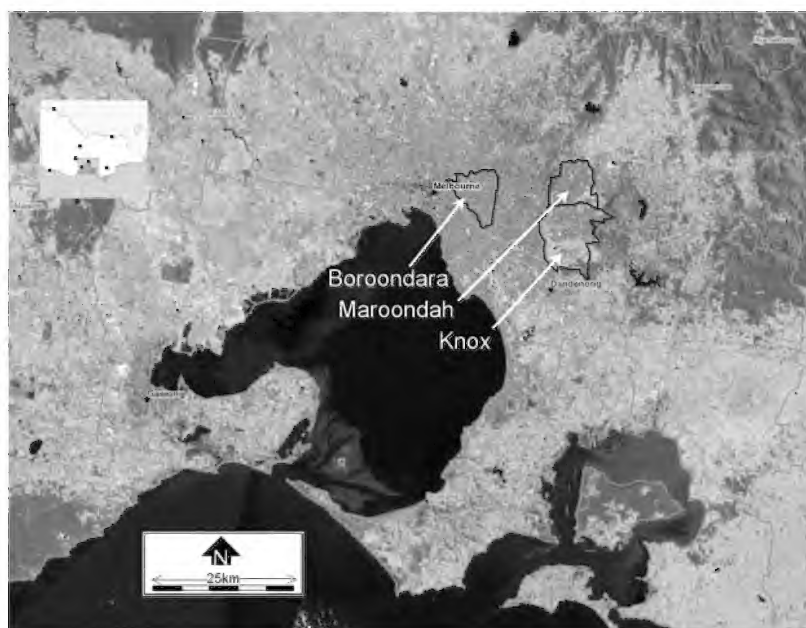


Figure 1. Satellite image of the Melbourne region, showing the three municipalities in this article. On land, the darkness of grey is an approximate indication of tree density.



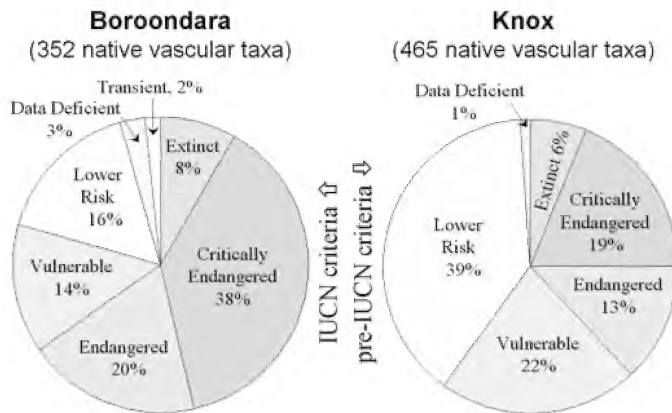


Figure 2. Summary of local extinction risks in Boroondara and Knox.

The effort required to conduct a thorough municipal-scale survey is large. For example, during the fieldwork for Knox, approximately 150 sites were surveyed and 27,000 records of plant observations were gathered (each record containing information about a single species at a particular location). Across the three municipalities, the number of plant records from the fieldwork exceeded all pre-existing records (e.g. from quadrat surveys, herbarium records and reports) by factors of between four and ten. Among the new records were dozens of species in each municipality that had not previously been recorded there, mostly species that are regionally rare. There were also many cases of prior records being found erroneous.

### Results

Perhaps the most important consequence of obtaining so much new data was a large shift in perceptions about many species' risks of local extinction. These risks were assessed for every indigenous species in Boroondara according to the IUCN (2003) regional guidelines for the Red List criteria. Similar (but more restrictive) criteria were used in the studies of the other two municipalities, which predated the 2003 guidelines. Results for Boroondara and Knox are summarised in Figure 2 (results from Maroondah are similar to Knox).

In each municipality, half to three-quarters of extant plant species were assessed as locally threatened. It is not unusual for high proportions of plant species to be threatened, even from the perspective of much larger spatial scales. For example, 45% of plant species in Victoria are listed as 'rare or threatened' (DSE 2005) on the basis of unpublished criteria. The most common threat factor faced by plants in the three municipalities was having a very small population size and little chance of natural recruitment from outside the municipality (IUCN criterion D). Additional species might be regarded as threatened, if only there were better data about their population trends.

The results from the three municipalities indicate that a considerable number of local extinctions should be expected

within several decades if corrective measures are not taken, even ignoring climate change. If such local extinctions were to also occur within other municipalities (as might be expected around larger Australian cities), we should expect the spatial distributions of most plant species to contract substantially, leaving lower local floral diversity and hence simpler (and perhaps less viable) native habitat.

Another important observation from the work reported here is that most patches of native vegetation have at least one locally threatened species. This makes it important to conserve as many patches of native vegetation as possible.

### Implications

The high incidence of locally threatened plants is not adequately dealt with by existing biodiversity policies, regulation and actions. Species that are threatened at national or state level are subject to well-developed protective measures, but most locally or regionally threatened species are not even recognised as such. Mechanisms such as permit systems for removal of vegetation are failing to redress the gradual loss of non-listed species from each municipality, because the problem of locally threatened species is not even recognised in most municipalities.

This situation can be changed. It requires:

- Improved municipal-scale field data, particularly including site specific information about population sizes and security;
- Determination of which species are locally threatened (the IUCN criteria appearing to be best suited);
- Monitoring and management programs for the affected species; and
- Recognition of locally threatened species in planning schemes, management plans and the policies and programs of local government.

The first two of these steps are now in place in the three municipalities discussed here, and the other two steps are being implemented. The author is also working to the same end at the neighbouring Manningham City Council.

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# “Live Local.....Plant Local”: The case for regional native botanic gardens

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The case for having regional native botanic gardens is compelling. Regional native botanic gardens make sense. They are a tool for promoting the use, and awareness of, local native plants in general. Their strength is their ability to influence the culture of plantings on *private land* and in domestic landscaping. They differ in two ways from a traditional botanic garden:

- they concentrate on showcasing and supplying the plants that are local to an area
- they tackle domestic landscaping head-on by offering a vision for a new Australian garden style. This can be in the form of formalized front-garden sized display gardens, which are relevant and attractive to local communities.

The aim of regional native botanic gardens is to promote and conserve the flora of each distinct region (eg. in South Australia we have: the Barossa; Clare Valley; Fleurieu; Yorke & Eyre Peninsulas; the South-East; Adelaide Plains and Coastal regions, all of which would be worthy of their own regional native botanic gardens). The advantages of using local species are well-known. Some of these include: low water use; addressing the issue of regional biodiversity loss; and building community pride and regional identity).

Barossa Bushgardens in Nuriootpa SA is a template for such a regional native botanic garden. This five year old community project is also a seed orchard as well as a sanctuary and learning centre for showcasing, supplying, harvesting and conserving a broad range of the Barossa Valley's 400 endemic plant species.

Regional native botanic gardens have many advantages:

- **environmental:** they are a sanctuary for locally threatened plants and a source of local native plants, which in turn provide preferred habitat which addresses regional biodiversity loss; they take pressure off wild seed sources. The impact of regional native botanic gardens goes far beyond one site. It can be catchment-wide: they are a vehicle for encouraging the use of local plants in the backyards of the region.
- **educational:** they offer an otherwise unavailable connection with local flora. Put simply, they familiarize a community with its own local native plants! The high level of public interest from the wider community and special-interest groups such as developers is proof of the need. They foster a spirit of experimentation and



*A display garden at the Barossa Bushgardens, with a 400 year old Red Gum in the background. Photo [XXXX]*

innovation in both plant management and landscape design. They are well suited to linking in with schools programs and lend themselves to ongoing strategic school involvement and educational outcomes.

- **economic:** they promote ecologically sustainable practices; employ local labour; attract ecotourism. Importantly, seedling sales help finance the project. There is an obvious ‘one-stop shop’ advantage which botanic gardens potentially have over nurseries in being able to display plants in situ as well as supply/sell them to the public on the same site.
- **social:** community ownership and volunteer ‘patch adoption’ schemes (every plant on the 2 hectares of plantings is ‘adopted’ by local community volunteers) serve a valuable bonding function, giving a sense of loyalty to local communities. People feel they are ‘making a difference’ by going local.
- **cultural:** they provide a flagship for the expression of regional identity.

A regional native botanic garden should be more than just a collection of plants. The Bushgardens’ community-run model demonstrates that multiple outcomes, particularly environmental and educational ones, are possible from the one project. Projects such as this are an effective way of addressing regional biodiversity loss in regional Australia by firstly familiarizing a community with its own local plants and secondly by making them available to that community.

**[Barossa Bush gardens logo to be inserted here]**  
**\*\*NEED\*\***

# Carnivorous plants in the Perth region – biology and challenges for conservation

John G Conran<sup>1</sup> & Allen Lowrie<sup>2</sup>

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South-western Western Australia has some of the highest diversity and endemism of carnivorous plants (CPs) in the world, but many of these are represented by small, fragmented populations (Lowrie 1987, 1998). The greater Perth region has arguably the greatest diversity of CPs for any urbanised area, particularly for Sundews (Droseraceae: *Drosera* 40 species), Bladderworts (Lentibulariaceae: *Utricularia* 8 species) and the Rainbow Plant (Byblidaceae: *Byblis gigantea*), all of which mainly now occur in pockets of remnant bushland or reserves. The rapid, ongoing expansion of urban development along the coastal sand plain has seen the removal of large areas of contiguous bushland, fragmenting or destroying populations of many of these species. Those that remain are threatened by problems arising from urbanisation (e.g. Lowrie 1980). These include not only direct land clearing, but changes to water tables, runoff patterns, water quality and the dramatic alteration of fire regimes on the sandplain. Accordingly, the challenges of conserving these taxa in an increasingly urbanised habitat are considered in terms of their biology and ecological requirements for survival, dispersal and recolonisation.

These plants are adapted to live in weed-free, open, often sandy areas, frequently at specific points along a water table gradient or in specialised microhabitats (Juniper *et al.* 1989). Many also show preference for highly localised soil subtypes (e.g. white vs yellow vs peaty sands, soaks vs lateritic hilltops etc...). The increased nutrient pollution of their habitats from urban runoff has resulted in CP loss through both nutrient toxicity and a concomitant weed invasion. An equally major threat is the lowering of the water table from domestic use, eliminating habitat around the once abundant seasonal swamps of the sand plain. As CPs are also highly intolerant of saline soils, salt incursions have further reduced populations or prevented recolonisation. Figure 1 shows examples of problems facing CPs in the Perth region.

Within the Perth region there are some 49 species of CPs (Western Australian Herbarium 1998-), with many reserves containing several taxa. Some of these are widespread and common (examples in Figs 2A-C). They could be used as biomonitors, giving an early warning of problems with the local ecology.

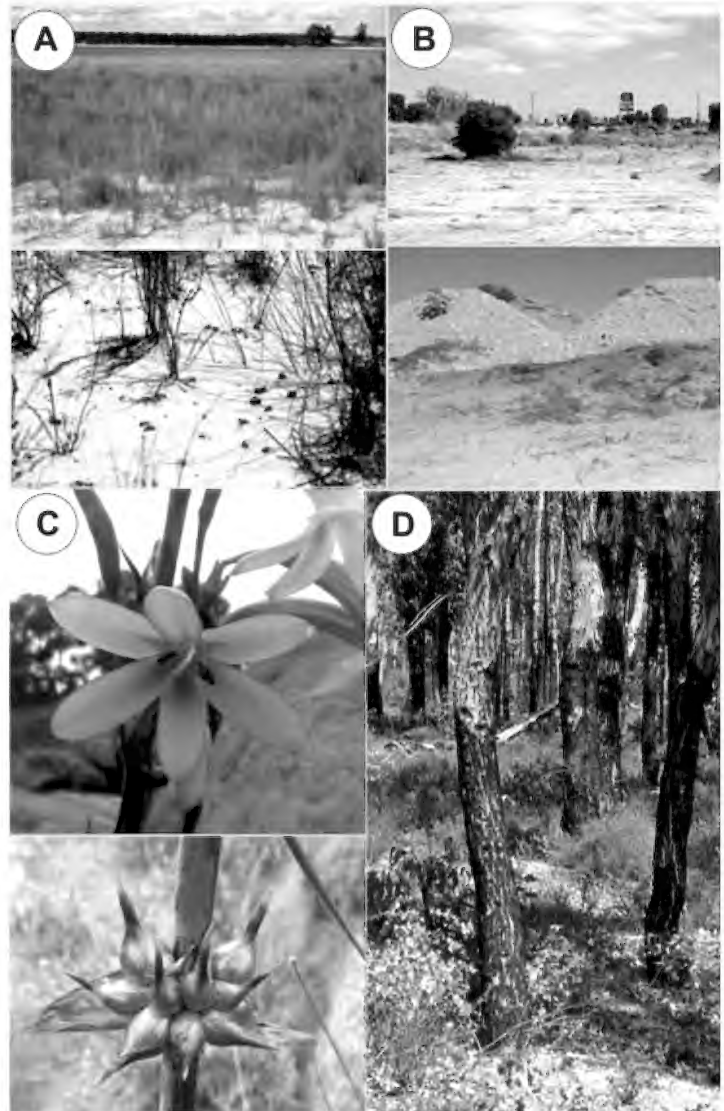


Figure 1. Examples of problems facing carnivorous plants (CPs) in the Perth region. A: Water table lowering at Lake Gnangarra and *Drosera nitidula* 'omissa'; B: Land clearing at Nicholson/Ranford Road area with *Byblis gigantea* attempting regrowth after grading; C: Weed invasion by *Watsonia meriana* var. *bulbillifera* at Red Hill in an area of heathland with 6 CP species; D: Regenerating recently burnt Darling scarp forest – fire prevention in urban areas reduces CP flowering and prevents regrowth and colonisation. Photos: JG Conran.

Their acute sensitivity to changes in habitat quality potentially make them suitable to flag problems in the early stages when remediation may still be an option (Ernst 2003).

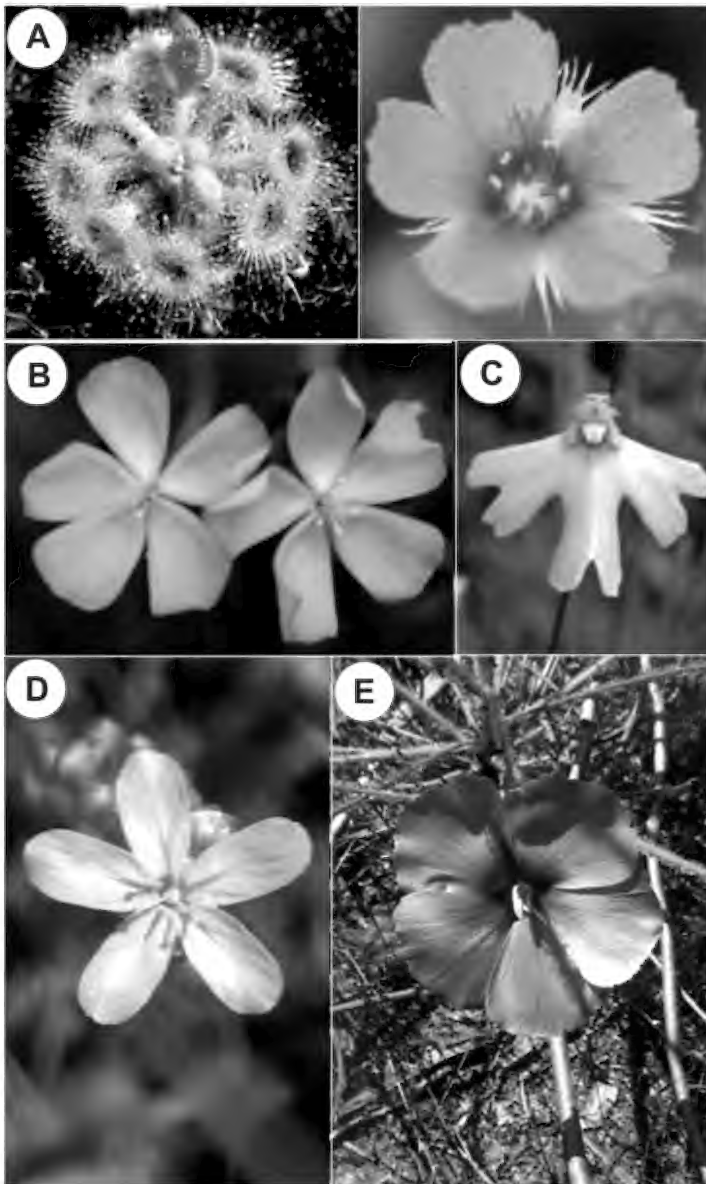


Figure 2. Examples of carnivorous plants of the Perth Region. A-D, common, widespread taxa, E-F, rare, localised species. A, B: *Drosera glanduligera*; C: *D. menziesii penicellaris*; D: *Utricularia multifida*; E: *D. oreopidion*; F: *Byblis gigantea*. Photos: JG Conran.

These plants have varying degrees of sexual versus asexual reproduction, so that many populations are both clonal (Karlsson and Pate 1992) and variably self-incompatible (Chen *et al.* 1997). Dispersal and establishment in many species is a combination of seasonal surface water movement, possible waterbird or ant dispersal, and also regular disturbance by fire in their habitats (Baird 1984). All of these processes have been severely curtailed, if not eliminated. This has resulted in tiny, genetically isolated populations that are potentially subject to the problems of founder effects and limited gene pools. Species with contracting ranges in the region or listed as rare (e.g. *Drosera occidentalis* subspecies *occidentalis*), isolated populations

(e.g. *Drosera paleacea* and *D. scorpioides*), or largely endemic taxa (e.g. *Byblis gigantea* (Fig. 3E), *D. oreopidion* (Fig 3D), *D. pygmaea* 'Perth form', *D. nitidula* 'omissa' (Fig. 2A) and *D. walyunga*) are particularly affected. Locally restricted hybrids, which in *Drosera* are a major pathway to speciation, are also threatened by habitat loss and alteration (e.g. *D. nitidula* 'omissa' x *D. pulchella* and *D. x badgerupii*).

If these plants, many of which are still actively in the process of rapid evolution and speciation, are to be conserved adequately, then urban planning decisions need to take into account not just the creation of reserves, but the maintenance and protection of their diverse habitats and ecological requirements.

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# City Slickers: Auckland's Urban Threatened Plants

Rebecca Stanley, Technical Support Officer - Threatened Plants, Auckland Conservancy, Auckland, Email: rstanley@doc.govt.nz

Auckland, New Zealand's largest city, is home to over a million people and 765 native plants. Around a half of Auckland's flora is regarded as either nationally or regionally threatened. The city is actively expanding in both urban spread as well as population numbers, thereby increasing pressure on what is left of our native and threatened flora. This poses a great many conservation challenges. We know we have lost 80 plants from the Central Business District of Auckland (Duncan and Young 2000) and 30 plants have vanished from the region.

Surprisingly a handful of nationally threatened plants have remained or appeared in unique inner-city habitats e.g. *Crassula huna*. I have used this example to demonstrate how effective it is in gaining attention. This miniscule succulent herb, naturally found in the splash zones of waterfalls and stream sides, has been found in an inner-city bowling green turf. While we have no idea how it got here, it has shed some light on the species ecology. The species remained within the turf for some years as it was tolerant of the main herbicides (glyphosate) used in the turf management. This is useful information as the main threat in the wild to the species is weed encroachment.

Other inner city species are remnants of potentially larger populations, which have persisted despite urbanisation spreading around them. *Fissidens berteroi* is a critically endangered fully aquatic moss that grows at four sites in New Zealand. It was first located in a volcanic aquifer fed wetland in central Auckland in 1882 and was rediscovered there in the 1980's. This same aquifer, which provides water to the moss, also supplies 5% of Auckland's drinking water. It is the remainder, after holding tanks have been filled, that flows into the water reserve for the moss. At least once a year there is not enough water left to flow into the moss habitat. Restoring the flow is critical for the persistence of this fully aquatic plant.

Water cannot be diverted from other supplies as this is the only non-fluoridated water supply in the region. Compromise is necessary and a hose and sprinkler system has been installed by the company to prevent the moss desiccating during the times when flows are absent. This is merely a short-term

solution as other species more resilient in drier conditions could out-compete the fissidens if the flow was absent for long periods. Long-term solutions involve continuing to communicate and working cooperatively with the company to explore further options.

This wetland has been the focus of a radio interview about the moss and proved to be another good example of the use of urban threatened plants as advocacy tools. The suburb is familiar to the majority of Auckland residents offering local appeal. It also offered the chance to use the site as a window into the past to when Auckland was dominated by wild habitats such as this wetland where plants prospered. The site also has novelty value as a small oasis surrounded by factories, graffiti, and noisy major roads. Urban plant sites are also accessible to the media who may require photos for an imminent deadline or who are unlikely to be able to access a remote site for a story.

Effectively engaging the community is imperative for plant conservationist and any means we have in order to connect plants and their stories with people should be utilised. Many urban situations also have an element of conflict, of which the media is fond, and the "bird-catching tree" *Pisonia brunoniana* is one example. This species is now very rare. In the wild rats predate seeds and seedlings and so it is now found primarily on predator-free islands.



Participants in the 2003 New Zealand Plant Conservation Network Fieldtrip at the Industrial Area where the critically endangered fully aquatic moss *Fissidens berteroi* is found. Photo: Beck Stanley

It is occasionally grown in gardens throughout the city and has attracted a lot of negative publicity as its sticky seed pods catch small (mainly exotic) birds which often die or are caught, by cats. This issue appears in the media annually when the plant bares seed and a small vocal group of people implore the authorities (including government departments and councils) to “ban” the tree as they discover dead and dying birds. This is an ideal opportunity to advocate the plight of a tree, which faces extinction on the mainland. It is a chance to speak on behalf of the plants and catch the attention of busy city people who often have never thought of threatened plants before. Our urban threatened plants serve as a constant reminder of our impact on the landscape and their stories are one tool we can use to help us connect our message with people and promote plant conservation

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*The moss Fissidens berteroi is monitored annually to investigate its status. Photo: Beck Stanley*



## Communities for Communities

*A new DEH Newsletter*

An ecological community is a naturally occurring assemblage of native species in the landscape. A number of ecological communities are considered threatened with extinction. The Australian Government has recognised the need to protect and recover these threatened ecological communities through listing as a matter of National Environmental Significance under the *Environment Protection and Biodiversity Conservation Act 1999*.

What ecological communities have been nominated for listing under the Act? What are the implications of listing? How can you find out if there are listed ecological communities in your region? What activities can be undertaken to help conserve these endangered remnants?

Find out the answers to these and more by subscribing to the Australian Government's e- newsletter **Communities for Communities**. This e-newsletter is specifically aimed at community groups and natural resource management bodies and contains information and pictures that they can use for their own publications, to spread the word about ecological communities.

The newsletter will also provide useful information on other matters of National Environmental Significance including:

- lists of new nominations and links to public consultation documents
- information about new listings
- information on recovery plans and threat abatement plans
- links to information and fact sheets
- feature articles about work the Department, community groups and individuals are doing to promote ecological communities and threatened species.

You will find the first edition at <http://www.deh.gov.au/biodiversity/threatened/publications/communities-newsletter/>. If you find the newsletter useful, follow the instructions on how to subscribe, and your details will be automatically added to our mailing list.

# Sustainable Landscapes: the big challenge and the many opportunities for plant conservation

Sheryn Pitman

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The Sustainable Landscapes project is a partnership between Delfin Lend Lease (Mawson Lakes Economic Development Project), Land Management Corporation, the Northern Adelaide and Barossa Catchment Water Management Board, SA Water Corporation, and the Botanic Gardens of Adelaide (SA Department of Environment and Heritage).

The project aims to demonstrate and promote appropriate park and garden design, plant species selections and sustainable horticultural practices for South Australian environments including effective, efficient and appropriate water use.

Why the Sustainable Landscapes Project? Many of our urban landscapes are unsustainable. They are resource-hungry artificial environments that require substantial inputs of energy such as water, nutrients, chemicals and power. They take considerable resources to keep them healthy but often give little back. For example, a typical urban park or garden requires regular watering to keep it green, fertilisers to keep the plants healthy, pesticides to control unwanted bugs and weeds, power tools to keep it neat and uses materials from other vulnerable landscapes to help create an appealing environment. The result is all too often a lush and green garden that is very thirsty and hungry, depletes the soil, contributes to waterway contamination and provides limited habitat for native fauna.

A sustainable landscape is a healthy and resilient landscape that will endure over the long term without the need for high input of scarce resources such as water. The natural functions and processes of the landscape are able to maintain themselves into the future.

How can this project contribute to plant conservation? The project has developed a set of criteria and guidelines for achieving a healthy urban ecology. These criteria are intended to guide the design and construction of parks and gardens, both public and private, and can be applied to all exterior landscape types. They cover design, plant selection, chemical use, energy consumption, habitat creation, water conservation and product/materials selection.

Plant research and collation of plant lists is a fundamental and ongoing aspect of the project. There are many plant lists available for different purposes but none that fulfil the criteria of sustainability as developed by the project.

A weed list has been generated by the project that integrates the CRC for Weeds Fact Sheet, the Urban Forest Biodiversity Program invasive species weed list, Weeds of National



*Normanville Foreshore Sustainable Garden under construction. Photo: S. Pitman.*

Significance and CSIRO's ten most invasive garden plants for sale in South Australia (these are available for each state).

The project is developing selections of recommended plants for various situations. The task of gathering, filtering and collating good plant information is progressing in consultation with project partners and industry professionals.

The project is also developing a series of demonstration sites through the greater Adelaide region, and as far afield as the Southern Fleurieu Peninsula and the Riverland. These sites include a diversity of urban landscape types from public parks and gardens to roundabouts, road verges, median strips and home gardens.

There are many issues to consider in planning and designing for urban plant conservation and market research into the garden industry may help us understand trends that may impact how urban plant conservation is addressed. For example, recent relevant market research indicates that:

- Water restrictions and water concerns continue to impact the garden market significantly and there is a perceived difficulty for gardening with slower sales in 'greenlife' and other garden products
- The strongest category in 'greenlife' sales has been 'trees and shrubs', and within this 'natives' showed above average growth
- The 'threats' and 'opportunities' arising from market place concerns about water use in gardening need to be assessed and managed

- Sales have seen positive growth in mulch and water saving products
- With increased family working hours and less leisure time, gardening skills are not being passed on through generations as in the past, inviting solutions that make gardening as simple as possible.

Our urban environments are seldom designed in harmony with our landscape and, with the exception of botanical gardens and remnant vegetation parks, are not designed to assist in plant conservation. There are however many ways in which urban landscapes have potential to contribute to plant conservation.



Adelaide Airport Roundabout under construction. Photo: S. Pitman.

## Research Roundup

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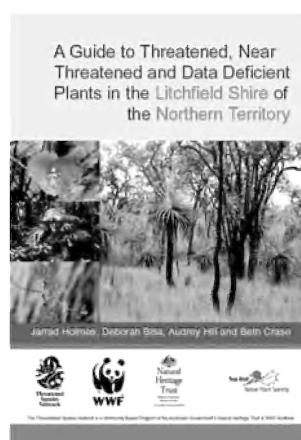
## Information Resources and Useful Websites

### A Guide to Threatened, Near Threatened and Data Deficient Plants in the Litchfield Shire of the Northern Territory

*J. Holmes, D. Bisa, A. Hill and B. Crase. 2005. Threatened Species Network*

The primary purpose of the book is to help locals in identifying and recording information on the plants of 'conservation concern' found within the Litchfield Shire, and through collation of this information enable better informed decisions and the conservation of the local plant

species. Just within the Shire alone there are 44 species that are listed as Data Deficient, that means that there is not enough information known about these plants to determine a status. With the community using this book and recording down relevant information, it is hoped that we may be able to fill in some of the knowledge gaps.



The book includes descriptions for 55 plant species, including information such as habitat preferences, known distributions, key distinguishing features and for the majority of species a photograph and/or diagram.

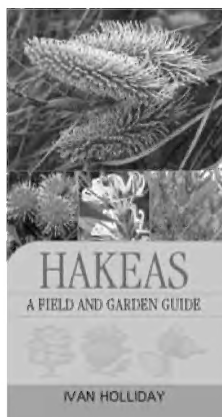
To act as an incentive for people to use the book, anyone who locates a plant featured in the book and has its identity confirmed by an expert, will be able to give the species a common name which will be documented by the Threatened Species Network. At present, only 9 of the 55 species featured have a documented common name.

Colour, 93 pages, \$12 and available by contacting the Threatened Species Network Northern Savannas coordinator on 08 8941 7554 or savannas@wwf.org.au

### Hakeas: A Field and Garden Guide

*I. Holliday, Aug 2005, CSIRO Publishing*

*Hakeas: A Field and Garden Guide* is the first fully comprehensive book on this plant group. It features all 148 species and 15 subspecies known. Paperback, ISBN: 1877069140, \$29.95. Available from CSIRO Publishing: <http://www.publish.csiro.au>.



### Woodlands: A Disappearing Landscape

*D. Lindenmayer, M. Crane, and D. Michael. Sept 2005, CSIRO Publishing*

Australia's little known woodlands once covered huge areas of the eastern side of our continent. In many cases only small remnant patches of some types of woodland survive. Understanding and appreciating woodlands is an important way forward for promoting their sustainable management and conservation. This book explains with lucid text and spectacular photographs the role that woodlands play in supporting a range of native plants and animals that has existed there for millions of years.

The book is set out as a series of logically linked chapters working from the woodland canopy, through the understorey, the ground layers, and to the lowest lying parts of landscape – wetlands, creeks and dams. Each chapter illustrates many key topics in woodland biology with text and images, explaining important aspects of woodland ecology as well as woodland management and conservation.

### WOODLANDS A DISAPPEARING LANDSCAPE



160 pages, Hardback, ISBN: 0643090266, \$39.95. Available from CSIRO Publishing: <http://www.publish.csiro.au>.

### New NSW Threatened Species Website

[www.threatenedspecies.environment.nsw.gov.au](http://www.threatenedspecies.environment.nsw.gov.au)

The new website provides detailed information, maps and photos of more than 900 of NSW's most vulnerable native plants and animals. The site was developed in response to a growing interest and need for ready access to detailed information about threatened species. It lists comprehensive ecological information, including photographs, drawings, and distribution maps of the 962 threatened species, endangered populations, and endangered ecological communities currently listed in NSW. The website includes the ability to search on CMA region or Local Government Area, providing a very valuable tool for all involved in threatened species management.

### Management of Total Grazing Pressure - managing Biodiversity in the Rangelands

Hard copies of a new publication 'Management of Total Grazing Pressure - managing Biodiversity in the Rangelands' are now available from the Dept of Environment & Heritage and will soon be available on the web. Please contact Neil Riches (Australian Government NRM Facilitator – Bushcare Ph: 08 9333 6708) for more information.

### Murni, Dhungang, Jirrar – Aboriginal uses of plants and animals in the Illawarra

*The Department and Environment and Conservation (NSW)*

This book is about Aboriginal people's uses of plants and animals in the Illawarra area, south of Sydney. The title means animal food (Murni), plant food (Dhungang) and fur (Jirrar) in Dharawal language. The book explores the spiritual and economic significance of various Illawarra environments - including marine, inter-tidal, estuarine, woodland and forest habitats - to the Aboriginal people of the Illawarra. Available from [http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Illawarra\\_Aboriginal\\_resource\\_use](http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Illawarra_Aboriginal_resource_use).

## Conferences and Workshops

### Rainforest meets Reef

22-24 Nov 2005, Southbank Hotel & Convention Centre, Townsville, Qld

Rainforest meets Reef, a joint conference of CRC Reef and Rainforest CRC, will highlight collaborative research solutions to environmental challenges in the tropics. Topics covered include: • Maintaining diversity in the face of change; and The role of science in conservation planning and management. For more information go to the conference website at: <http://www.reef.crc.org.au/about/events/jointconference.htm>.

### Ecological Society of Australia Annual Conference

29th Nov – 2nd Dec 2005. The University of Queensland, St Lucia, Brisbane, Qld

The opening plenary will examine the science behind the likely effects of climate change on Australia's biodiversity and ecosystems. The symposia will focus on a range of topical issues for ecology in Australia, and indeed the world, including: Large-scale restoration and recovery of extensively modified ecosystems, and Threatened species and biodiversity conservation: using science in law. For more information go to: [http://www.ecolsoc.org.au/Conference/ESA2005/ESA2005\\_000.htm](http://www.ecolsoc.org.au/Conference/ESA2005/ESA2005_000.htm)

### Fruit and seed morphology workshop

Feb 2006, Mt Annan Botanic Garden, Mt Annan, New South Wales

Mt Annan Botanic Garden are hosting a fruit and seed morphology workshop presented by Dr Wolfgang Stuppy, a Seed Morphologist from the Millennium Seed Bank (RBG Kew, UK) early next year. There will be opportunities to bring fruit and seed along to examine during the course. This is a great opportunity and we hope to involve Australian Millennium Seedbank partners, university staff

and students, DEC colleagues and other people working with seed and fruit of Australian plants. For further information contact Amelia Martyn, Seed research officer, Mount Annan Botanic Garden, Phone: 02 4634 7968. Email: [amelia.martyn@rbgsyd.nsw.gov.au](mailto:amelia.martyn@rbgsyd.nsw.gov.au)

### Veg Futures 2006: The conference in the field

19th – 23rd March 2006, Albury-Wodonga

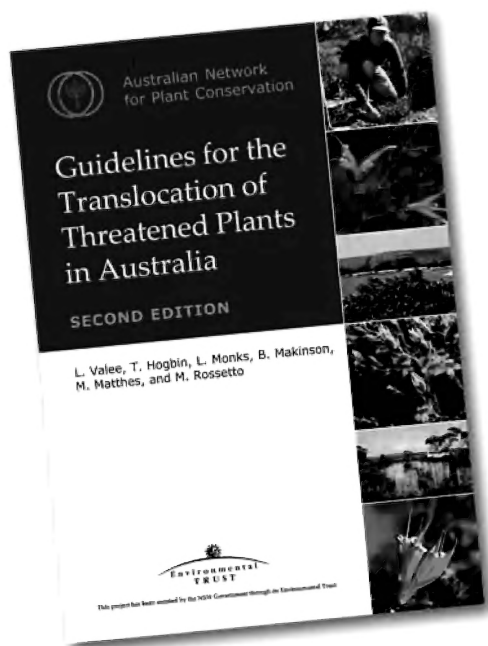
*Veg Futures 2006* will be a participatory conference on the role of vegetation in productive landscapes: from policy to regional planning and into practice. *Veg Futures 2006* will provide an opportunity for anyone involved in vegetation management at the regional level to have their say, pass on their knowledge and experience to others, and pick up some new ideas.

This is a conference for tree planters, regional planners, bush managers, policy makers, direct seeders, researchers, seed collectors, extension agents, botanists, teachers and trainers, bush regenerators and sustainable farmers and graziers.

*Veg Futures 2006* will tackle the "big questions" about native vegetation in Australia including:

- What is the role and value of vegetation in the regional landscape?
- Who pays for vegetation management?
- How do we balance competing demands for conservation and production?
- What are we doing about the threats to native vegetation (action and on-ground works)?
- How do we know if we are making a difference (monitoring and evaluation)?

For more information go to: <http://www.greeningaustralia.org.au>.



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*Enquiries: Joan Overeem*

*Ph: 02 6767 1518 or email: [jovereem@aapt.net.au](mailto:jovereem@aapt.net.au)*



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## Australasian Plant Conservation

BULLETIN OF THE AUSTRALIAN NETWORK FOR PLANT CONSERVATION

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